

## CRYOGEN USE AT TA-53 STACK SYSTEMS

### Purpose

This Air Quality Group procedure describes processes used to fill and maintain liquid nitrogen systems used in the TA-53 stack monitoring systems. Processes include filling dewars with liquid nitrogen and maneuvering supply dewars with the jib crane at the TA-53 "TOFI" area.

### Scope

This procedure applies to individuals from ESH-17 (Air Quality) and ESH-1 (Health Physics Operations) who are assigned to fill the liquid nitrogen systems at TA-53 stack monitoring stations.

### In this procedure

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### Hazard Control Plan

The hazard evaluation associated with this work is documented in Attachment 1: Initial risk = **medium**. Residual risk = **low**. Work permits required: **none**. First authorization review date is one year from group leader signature below; subsequent authorizations are on file in group office. Work authorization applies only to ESH-17 employees; it is the responsibility of the supervisors of personnel from other groups performing this process to ensure all applicable hazard analyses have been performed according to applicable requirements.

### Signatures

Prepared by:  David Fuehne, Rad-NESHAP Project Leader	Date:  <b><u>3/5/2001</u></b>
Approved by:  Terry Morgan, QA Officer	Date:  <b><u>3/5/01</u></b>
Approved by:  John Bliss, ESH-1/TA-53 Team Leader	Date:  <b><u>4/11/01</u></b>
Work authorized by:  Doug Stavert, ESH-17 Group Leader	Date:  <b><u>4/17/01</u></b>

05/14/01

## CONTROLLED DOCUMENT

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## General information about this procedure

**Attachments** This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Hazard Control Plan	2
2	Ordinary Lift Procedure	3

**History of revision** This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	5/9/01	New document.

**Who requires training to this procedure?** The following personnel require training before implementing this procedure:

- Members of ESH-17 staff deployed to TA-53 to coordinate stack monitoring efforts
- Members of ESH-1 team deployed to TA-53, assisting in stack monitoring effort as part of routine maintenance

**Training method** The training method for this procedure is **on-the-job** training by a previously-trained individual and is documented in accordance with the procedure for training (ESH-17-024).

**Prerequisites** In addition to training to this procedure, the following training is also required prior to performing this procedure:

- Cryogen Safety for all users: course #8876
- Incidental Crane Operator for users maneuvering supply dewars with crane: course #20295 (classroom) and #20296 (examination)
- Facility-specific training for unescorted access to TA-53 experimental areas: course #9693
- Limited access area training to access the ES-2 stack station in the MEB: course #18825

## General information, continued

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<b>Definitions specific to this procedure</b>	<u>LN</u> : Liquid nitrogen, a common cryogenic fluid. Used at TA-53 stack stations to keep high-purity germanium detectors at near absolute-zero temperatures, thus optimizing their performance.
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<b>References</b>	The following documents are referenced in this procedure: <ul style="list-style-type: none"><li>• ESH-17-024, “Personnel Training”</li></ul>
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<b>Note</b>	Actions specified within this procedure, unless preceded with “should” or “may,” are to be considered mandatory guidance (i.e., “shall”).
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## Overview of Process

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### Reason for cryogen use

The major radioactive air emissions from the Los Alamos Neutron Science Center (LANSCE) at TA-53 are radioactive gases. These gases cannot be sampled with “traditional” methods (e.g., capture on sample media) and have very short half-lives. Therefore, continuous monitoring of gaseous radionuclides is required during LANSCE operations.

The best method for discriminating the various components in the emissions air stream is by using a high-purity germanium (HPGe) detector. These detectors must be kept at liquid nitrogen temperatures in order to operate.

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### Systems using cryogens

The two main emissions stacks for the experimental areas at TA-53 are Building 3M, Exhaust Stack 03, and Building 7, Exhaust Stack 2. In this procedure, these stacks are referenced as ES-3 and ES-2, respectively. Each stack has a primary HPGe detector, referred to as the ES-3 HPGe and the ES-2 HPGe.

An additional HPGe detector is installed at the ES-3 stack station, on a separate exhaust duct that leads to the main stack plenum. A fourth HPGe detector is used at the TA-53 ESH-1 counting laboratory in Building 3R. ESH-17 infrequently uses these two detectors for special analyses of emissions samples. Their liquid nitrogen supplies are maintained in a manner identical to this procedure.

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### Cryogen supply

The Gas Plant at Los Alamos National Laboratory has supply trucks that service TA-53 on a weekly basis (Thursday mornings). Large supply dewars left out in designated areas will be filled by Gas Plant personnel during the weekly supply trips.

Special supply trips can be coordinated with the Gas Plant (667-4406) if needed (e.g., prior to extended holiday shutdowns, etc.) Information such as name, z-number, cost information, and location is required.

## Overview of Process, continued

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### Liquid nitrogen dewars

The emissions monitoring program uses two 160-liter “supply dewars” for the primary liquid nitrogen supply. These supply dewars are used to directly fill the stack detector dewar (30 liter) on the ES-3 HPGe and the secondary HPGe detector (also 30 liters) at the ES-3 stack station.

The supply dewars are also used to fill small, 10-liter “transport dewars” with liquid nitrogen. These transport dewars are hand-carried to the ES-2 stack station to fill the ES-2 HPGe detector dewar (30 liter volume).

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### Low oxygen situations

The TOFI area is where the large supply dewars are stored; the potential exists for low-oxygen situations if a supply dewar ruptures. An oxygen alarm is installed in TOFI to detect such situations. If the oxygen monitor alarms during this procedure, **exit the area immediately** and contact CCR.

Due to the size of the dewar (lower LN supply) and the size of the room at the ES-2 stack station, a low-oxygen situation is not possible.

## Filling Supply Dewars

### Supply dewar location

The two 160 Liter supply dewars are kept in the ES-3 stack monitoring station at the “TOFI” area (TA-53, Building 3M, room M105). This area is recessed approximately five feet below the ground level of the rest of building 3M.

### Fill location

The supply dewars are filled by the LANL Gas Plant, as noted earlier. To be filled, the dewars must be moved to outside the Area A southwest roll-up door. This is located in the southwest quadrant of Area A (TA-53 Building 3M, room M100). Area A and the TOFI area share a common wall, and there is an equipment access area along this common wall. This access area has a removable railing and a jib crane (ID number CJ-1) to move heavy equipment from Area A into and out of the TOFI area.

### Moving the dewars

The dewars are rolled from the TOFI area into the Area A access area. There, they must be rigged for crane lifting in accordance with LANL crane policy. Once lifted into Area A, they are rolled to their fill location. The process is repeated in reverse to return the filled dewar to the TOFI area.

**Note:** A filled dewar weighs approximately 550 pounds; the empty dewar is 220 pounds, and 160 liters of LN is about 285 pounds. The attached hand-truck is about 40 pounds.

### Cone of Safety

During all lifting operations, maintain the “Cone of Safety” as described in crane operator training. All personnel within the cone of safety must use proper PPE. Normally, there is no need for anyone to be within the danger zone.

### Steps to fill supply dewars

To fill the supply dewars, perform the following steps

Step	Action
1	Determine if the supply dewar needs filling by examining the floating rod at the top of the dewar. If the rod indicates that less than one third of the supply dewar is remaining, perform these steps to fill the dewar.
2	<b>If you are not certified</b> to use the jib crane at the Area A – TOFI access area, <b>do not perform the remaining steps in this chapter.</b> Notify the rad air emissions staff that the supply dewar(s) need filling.
3	Obtain the key for the jib crane from the ESH-1 field office or other designated location.
4	Verify that the crane is up-to-date on annual and monthly inspections; if not, request emissions staff to coordinate inspections ASAP. <b>Do not perform the remaining steps of this chapter.</b>

*Steps continued on next page.*

## Filling Supply Dewars, continued

Step	Action
5	If it has not yet been done that day, perform the crane daily inspection. If the inspection reveals an unsafe situation, <b>skip the remaining steps of this chapter.</b>
6	Inspect the rigging and verify that it is within the annual certification. If there is a problem with the sling or rigging, or if the certification has expired, request Emissions staff to coordinate a solution ASAP. <b>Skip the remaining steps of this chapter.</b>
7	Move the supply dewar into position under the jib crane.
8	At the Area A hoist, remove railing on east side of TOFI access area. Notify personnel in the TOFI area that you will be moving a dewar containing LN and remind them to stay out of the cone of danger area under the load.
9	Don required <b>hard hat</b> and ensure you are wearing <b>steel-toed shoes</b> . Rotate hoist and lower the hook until it is about one foot above the top of the supply dewar.
10	Each dewar should have rigging permanently attached to its top. If not, rigging is available in the locked cryogen cabinet in TOFI. Rig the sling <b>through the shackles that are installed through the lift holes</b> and onto the hook, consistent with methods described in Incidental Crane User training.
11	At the hoist control, lift the dewar to just above the Area A ground level; rotate hoist so dewar is completely over the Area A floor. <b>CAUTION:</b> Be careful that crane chain does not tangle in the fixtures on the top of the dewar. Hold the chain away from the dewar while raising and lowering it, or have a partner assist.
12	Lower dewar to floor.
13	Remove rigging from hook.
14	Replace railing at TOFI access area.
15	Rotate hoist arm and hook away from traffic area.
16	Lock out crane to prevent unauthorized use.
17	Roll dewar to southwest roll-up door of Area A and open door.
18	Roll dewar to “fill zone” outside of roll-up door; close roll-up door.
19	After dewar has been filled, roll dewar back to hoist area through roll-up door.
20	Repeat steps 3-6 to prepare crane for use to lower dewar into TOFI.
21	Rig sling on the supply dewar.
22	Raise dewar; lower into TOFI access area, remove rigging from hook.
23	Secure hoist arm and hook out of traffic path.
24	Lock out crane to prevent unauthorized use.
25	Roll supply dewar into TOFI; it is now ready for use.

## Filling ES-3 Detector Dewars

**ES-3 dewars** There are two dewars at the ES-3 stack station; one on the primary stack HPGe and one on the duct sampling HPGe. Both should be filled according to this procedure.

**Supply dewars** It is assumed that at least one supply dewar is available, approximately half-full or more.

**Required PPE** The following PPE is required for this process:

- face shield
- gloves (available in the locked cabinet)
- long sleeves (a lab coat is available in the locked cabinet)
- full-length pants (coveralls can be obtained from the ESH-1 field office or decon trailer)
- closed-toe shoes (booties can be obtained from the ESH-1 field office or decon trailer)

**Steps to fill ES-3 dewars** To fill the ES-3 dewars, perform the following steps:

Step	Action
1	Roll the supply dewar until it is next to the ES-3 stack HPGe detector.
2	Using the attached tubing, connect the supply dewar to one of the vents at the top of the detector dewar (just under the shielding support). If tubing is not attached to the supply dewar, it should be in the locked cabinet. If none is available, request Emissions staff to solve the problem and skip the remaining steps in this chapter
3	Ensure that nothing is obviously blocking the other detector dewar vent
4	Don cryogenic PPE (see block above).
5	Slowly open the valve associated with the connection to the detector. Listen for the sound of LN flowing into the detector.
6	Observe the top of the detector dewar; nitrogen vapor exiting the detector should be visible and audible. If not, stop filling and request staff assistance.
7	If everything appears normal, continue filling the detector. Do not leave the area while the dewar is filling. When the detector is filled, droplets of liquid nitrogen (or a stream of liquid) will come out of the vent along with vapor. At this point, turn off the LN valve on the supply dewar and remove the fill hose from the detector dewar.

*Steps continued on next page.*



## Filling ES-3 Detector Dewars, continued

Step	Action
8	Make a note on the LN2 log with the time & date the dewar was filled.
9	Roll the supply dewar to the other detector in TOFI and repeat the above steps. If staff has noted that this detector does not need filling, skip this step.
10	When complete, return the supply dewar to its storage area.
11	Doff PPE and store them in the locked cabinet.

## Filling ES-2 Detector Dewar

**ES-2 dewars** There is one 30-liter detector dewar at the ES-2 stack station in Building 7, room 200 (the Mechanical Equipment Building, MEB). Note that there are special access restrictions to enter this room, as described in TA-53 Limited Access Area training.

**Supply dewars** One cannot bring the large 160-liter supply dewars into this area, due to access constraints (stairs, etc.). Rather, transport dewars (10-liter) are used to carry LN from the supply dewars in TOFI to the ES-2 stack station.

It is assumed that at least one supply dewar is available, approximately half-full or more.

**Steps to fill ES-2 dewars**

To fill the ES-2 dewars, perform the following steps:

Step	Action
1	Obtain at least one transport dewar (approximately 10 liter volume). These dewars are stored in TOFI, or in the MEB.
2	Don PPE as described in the previous chapter, step 4.
3	Remove the loose “plug” at the top of the transport dewar; this plug minimizes evaporation of LN and acts as pressure relief for the dewar.
4	Insert the tubing from the supply dewar approximately 6 inches into the neck of the transport dewar. If tubing is not attached to the supply dewar, it should be in the locked cabinet with the rigging sling. If none is available, request Emissions staff to solve the problem and skip the remaining steps in this chapter .
5	Slowly open the supply dewar valve associated with the tubing. The LN transfer is audible, and vapors from the transport dewar will be visible.
6	Hold the tubing in place during the transfer, until the LN causes the tubing to freeze into place.
7	Using a flashlight if necessary, determine level of LN in the transport dewar. When level is within six inches of the top, shut off the supply dewar.
8	Carefully remove the tubing from the neck of the transport dewar, being careful not to crack the tubing.
9	Replace the loose plug in the transport dewar.
10	Carry transport dewar to the MEB; wearing face shield is unnecessary for this step.

*Steps continued on next page.*

## Filling ES-2 Detector Dewar, continued

Step	Action
11	At the ES-2 detector station, locate the PPE box just to the right of the ES-2 HPGe detector stand.
12	Locate the funnel and tubing, connected to the south vent on the HPGe detector dewar. If not installed, the funnel should be in the PPE box; mount the funnel to the detector dewar vent with tape or wire. If the funnel is not in the PPE box, request Emissions staff to resolve issue and postpone the remaining steps of this chapter.
13	Locate the vent tube, similar to the funnel, on the north vent of the detector dewar. This tube allows one to observe vented vapor and liquid nitrogen while pouring LN into the funnel.
14	Don cryogenic PPE as described in previous chapter, step 4.
15	Remove the loose plug from the transport dewar.
16	Carefully pour LN from the transport dewar into the funnel.
17	Observe the vent tube; vapor should be coming out of this vent tube as LN is added to the dewar. If nothing is coming out, cease filling the dewar and investigate. Request rad air emissions staff to resolve issue if a solution is not readily apparent.
18	When liquid droplets begin coming out of the vent tube, the detector dewar is full. Stop pouring LN into the funnel and wait for funnel contents to drain into detector dewar.
19	Replace the plug in the transport dewar.
20	Replace PPE in the box in the MEB.
21	Make a note on the LN2 log with the time & date the dewar was filled.
22	If a substantial amount of LN remains in the transport dewar, leave the dewar behind the PPE box in the MEB. Make a note on the supply dewars at TOFI that a dewar is at the MEB.
23	If the transport dewar is nearly empty, carry the dewar back to TOFI for re-use.

## Records resulting from this procedure

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### Records

The following records generated as a result of this procedure are to be maintained by TA-53 ESH-17 staff

- Log of detector LN fill for the HPGe detector dewars at the ES-2 stack, ES-3 stack, and ES-3 auxiliary detector.

## HAZARD CONTROL PLAN

1. The work to be performed is described in this procedure:

### “CRYOGEN USE AT TA-53 STACK SYSTEMS”

2. Describe potential hazards associated with the work (use continuation page if needed).

- a) Crane usage: dropping a load onto floor, equipment, or individual
- b) Liquid nitrogen use: cryogenic burns from skin contact with LN
- c) Oxygen deficiency: if supply dewar ruptures, a low oxygen situation will develop in TOFI (TA-53, Building 3M, room M105).
- d) Accident scenario: during operations to the 1L Target, the stack station at Building 7, ES-2 is inside a “Limited Access Area” due to excessive external dose rates encountered if a design basis accident occurs

3. For each hazard, list the likelihood and severity, and the resulting initial risk level (before any work controls are applied, as determined according to LIR300-00-01.0, section 7.2)

- a) Crane usage: Occasional / Critical = Medium
- b) Liquid nitrogen use: Occasional / Moderate = Low
- c) Oxygen deficiency: Improbable / Critical = Low
- d) Accident scenario: Remote / Catastrophic = Medium

Overall *initial* risk: ☐ Minimal ☐ Low ☒ Medium ☐ High

4. Applicable Laboratory, facility, or activity operational requirements directly related to the work:

☐ None ☒ List: Work Permits required? ☒ No ☐ List:

LIR-402-706-01 “Personnel Dosimetry”

LIR-402-580-01.1 “Cryogen Use or Cryogenics”

AR-13-2 “Cranes, Hoists, Lifting Devices, and Rigging”

“Ordinary Lift Procedure” to lift LN dewars with Area A jib crane (Attachment 2 of this procedure)

### HAZARD CONTROL PLAN, continued

5. Describe how the hazards listed above will be mitigated (e.g., safety equipment, administrative controls, etc.):

- a) Crane usage: All operators trained as an Incidental Crane User (see info below). Rigging, crane usage, and inspections performed in strict accordance with training. Personal Protective Equipment (PPE) worn by crane operator and all individuals within cone of safety.
- b) LN Usage: Proper PPE worn by all individuals filling LN dewars. Training in cryogenic safety by all individuals filling LN dewars
- c) O<sub>2</sub> Deficiency: Oxygen monitor in TOFI area with audible alarm. Crane operators will notify workers in the TOFI area prior to any lift to raise their awareness. Be cognizant of escape routes if needed (see section 9).
- d) Accident scenario: All workers entering the Mechanical Equipment Building (Bldg 7, room 200, location of the ES-2 stack station) during beam operations require TA-53 "Limited Access" area training. All requirements stated in the training shall be followed, including use of supplemental dosimetry as required.

6. Knowledge, skills, abilities, and training necessary to safely perform this work (check one or both):



Group-level orientation (per ESH-17-032) and training to this procedure.

Other → See training prerequisites on procedure page 2. Any additional describe here:

7. Any wastes and/or residual materials? (check one) ☒ None ☐ List:

8. Considering the administrative and engineering controls to be used, the *residual* risk level (as determined according to LIR300-00-01.0, section 7.3.3) is (check one):



Minimal



Low



Medium (requires approval by Division Director)

9. Emergency actions to take in event of control failures or abnormal operation (check one):



None



List:

Exit area immediately if oxygen monitor alarms. There are two exits from TOFI; up the stairs on the east wall center, and through the double doors on the east wall (south end), climbing up the access port. Use the exit nearest your location. Proceed to muster area south of building 3M. Note: there are no exits on the north, south, or west sides of the TOFI room (3M-105).

Contact LANSCE Central Control Room (CCR) at 667-5729 in any emergency. For radioactive hazards, also contact the ESH-1 Field Office at 667-7069.

Signature of preparer of this HCP: This HCP was prepared by a knowledgeable individual and reviewed in accordance with requirements in LIR 300-00-01 and LIR 300-00-02.

Preparer(s) signature(s)

Name(s) (print)

/Position

Date

Signature by group leader on procedure title page signifies authorization to perform work for personnel properly trained to this procedure. This authorization will be renewed annually and documented in ESH-17 records. Controlled copies are considered authorized. Work will be performed to controlled copies only. This plan and procedure will be revised according to ESH-17-022 and distributed according to ESH-17-030.

## ORDINARY LIFT PROCEDURE

**Los Alamos**

NATIONAL LABORATORY

### ORDINARY LIFT PROCEDURE

#### GENERAL INFORMATION

Team Members ESH-17 and ESH-1 personnel assigned to LANSCE-FM				
Item To Be Rigged 160-Liter Liquid Nitrogen (LN) dewar, with attached hand-truck	Weight approx 550 lbs	Height six feet	Width 30 inch diam	Length 30 inch dia.
Sketch load with approximate center of gravity.  SEE PICTURES IN ESH-17-617. CENTER OF GRAVITY IS ALONG VERTICAL CENTER AXIS OF LN DEWAR				

#### LIMITATIONS

Head Height Jib crane height approx 8 feet above ground level in Area A	Attachment Points Use ONLY designated "pick points;" DO NOT use top ring
Vertical Lift from TOFI level (basement) to Area A ground level, approx 4 feet	Load Bending or Crushing
Horizontal Travel Limited rotation from jib crane track, fixed to wall beam	Obstructions Railing at east side of TOFI access must be removed
Other (Explain) Full dewar contains LN; if dropped/ruptured, a cryogen hazard & low-oxygen hazard will exist. EXIT AREA if accident occurs	

#### LIFTING OR TRAVELING DEVICES

Check the appropriate box(es).		
<input type="checkbox"/> Mobile Crane	<input type="checkbox"/> Griphoists	<input type="checkbox"/> Hardwood Roller
<input type="checkbox"/> Overhead Bridge Crane	<input type="checkbox"/> Jacks	<input type="checkbox"/> Electric Winch
<input type="checkbox"/> Manual Chain Hoist	<input type="checkbox"/> Air Bags	<input checked="" type="checkbox"/> Dolly Cart
<input checked="" type="checkbox"/> Electric Chain Hoist	<input type="checkbox"/> Levers	<input type="checkbox"/> Other (Explain)
<input type="checkbox"/> Lever Chain Hoist	<input type="checkbox"/> Hillman Rollers	

#### SLINGS AND SHACKLES

Check one or more and give the rated capacity.						
Hitch Types						
<input type="checkbox"/> Vertical	<input type="checkbox"/> Choker	<input type="checkbox"/> Basket	<input checked="" type="checkbox"/> 2-Leg 2 ton	<input type="checkbox"/> 3-Leg	<input type="checkbox"/> 4-Leg	<input type="checkbox"/> Other
Sling and Shackle (Types and Sizes)						
<input type="checkbox"/> Wire Rope	<input checked="" type="checkbox"/> Flat Web 2 ton	<input type="checkbox"/> Round Web	<input type="checkbox"/> Alloy Chain	<input checked="" type="checkbox"/> Shackle 2+ ton	<input type="checkbox"/> Other	
Miscellaneous Gear						
<input type="checkbox"/> Strongback	<input type="checkbox"/> Spreader Bar	<input type="checkbox"/> Plate Clamp	<input type="checkbox"/> Universal Hoist Ring	<input type="checkbox"/> Other		

#### LIFT, MOVEMENT, AND PLACEMENT SEQUENCE

Sketch and describe in detail on the back of this sheet. SEE PROCEDURE ESH-17-617
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#### APPROVALS

Operations or Line Manager (Printed Name) Doug Stavert (additional sign off @ procedure)	Signature	Date
Designated Leader (Printed Name) David Fuehne, ESH-17/LANSCE	Signature David Fuehne	Date 10/20/2007

Photo 1: 160-Liter dewar  
& attached hand-truck



Photo 2: LN Dewar slung  
& ready for lift



Photo 3: Front pick point  
(opposite hand truck)



Photos 4 & 5: Two side views of back pick point. Pick point is also used as a connection point to hand truck, so a smaller shackle is used to keep weight of load on pick point “ear” and not on top horizontal manipulating ring.





## Crane Lift & Rigging Calculations

Mass of empty liquid nitrogen dewar: 220 pounds empty *Canberra web site*

Mass of liquid nitrogen:

Density = 0.8081 g/cm<sup>3</sup>

*CRC Handbook*

Volume = 160 liters = 160,000 cm<sup>3</sup>

Mass of LN = 129,300 g = 129.3 kg = 285 pounds

Mass of hand-truck = 50 pounds (estimate)

Total mass of load = 555 pounds

Crane: Jib Crane #CJ-1, Wright-Way hoist, capacity = 1000 pounds (½ ton).

Rigging:

Web sling: 4000 pound capacity

Shackle (large): 9500 pound capacity (used on side opposite hand truck; see picture #3)

Shackle (small): 4000 pound capacity (used on side with hand truck; pictures #4-5)

Rigging Style:

Two-leg hitch: full capacity of sling (4000 pound)

Angle of “leg” = 60 degrees (approximate; see photo #2, previous page)

Load multiplier for this angle = 1.155 (1/sin(60))

Two-leg hitch: ½ load on each leg, with load multiplier

555 pounds \* ½ \* 1.155 = 320 pounds each leg

Total effective load = 640 pounds.

This is well within the limit of the rigging and the load capacity of the crane and is NOT a critical lift.